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In re Application of: Yi-Feng Wang

For: HIGH TEAR STRENGTH LOW COMPRESSION SET HEAT CURABLE SILICONE ELASTOMER AND ADDITIVE

NEW APPLICATION TRANSMITTAL

APPLICATION
Honorable Commissioner of
Patents and Trademarks
Washington, DC 20231

Sir:

Transmitted herewith are the following documents in the above-identified application:

X Original Application, consisting of a specification of 23 pages, including claims of 5 pages and an abstract of 1 page.

_ Information Disclosure Statement

_ PTO 1449 Form

_ Copies of References Cited

X Assignment Cover Letter and Assignment of the Invention to General Electric Company

X Declaration or Oath

_ _ Sheets of Drawing

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HIGH TEAR STRENGTH LOW COMPRESSION SET HEAT CURABLE SILICONE ELASTOMER AND ADDITIVE

FIELD OF THE INVENTION

The invention relates to high tear strength, low compression set, low cost heat curable silicone elastomers.

BRIEF DESCRIPTION OF THE RELATED ART

Silicone heat curable elastomers (HCE) generally consist of diorganopolylsiloxane gum, fluid and silica filler. Silica filler acts as a reinforcing component to provide mechanical strength. Generally, fumed silica based HCE compounds provide good mechanical properties with intermediate tear strength and poor compression set.

Current HCE compounds are typically molded and produce products exhibiting excellent tear resistance with compression sets greater than 70%, thus requiring post baking to reduce the compression set to less than 40%. It would also be a great benefit to obtain an addition cure HCE with low compression set immediately upon molding while maintaining excellent tear strength and Shore A hardness. It would be a great benefit to obtain a HCE system offering low cost, good mechanical properties, high tear strength and low compression set upon curing, eliminating the need for post baking.

SUMMARY OF THE INVENTION

The present invention is directed to a curable composition comprising: (a) an alkenyl terminated linear diorganopolysiloxane gum; (b) an alkenyl containing diorganopolysiloxane gum; (c) a precipitated silica reinforcing filler with surface area of from about 90 to 300 m^2/g; (d) a hydroxy

terminated polysiloxane fluid; (e) an organohydrogenpolysiloxane; (f) a low compression set additive; (g) an addition-cure catalyst, and to a silicone elastomer formed by curing the composition. The cured silicone elastomer has high tear strength and low compression set upon curing and is produced at a lower cost.

Precipitated silica filler based HCE compounds provide excellent compression set but traditionally exhibit poor tear strength. The precipitated silica filler offers significant cost savings versus fumed silica filler. When used in combination with the low compression set additive of the present invention, a HCE compound providing high tear strength and low compression set is produced.

DETAILED DESCRIPTION OF THE INVENTION

In a preferred embodiment, the composition of the present invention comprises, based on 100 parts by weight of the composition, from 60 to 98 parts by weight ("pbw"), even more preferably from 75 to 95 pbw, of the alkenyl terminated diorganopolysiloxane gum; from 2 to 40 pbw, even more preferably from 15 to 25 pbw, of the alkenyl-containing diorganopolysiloxane gum; from 10 to 200 pbw, even more preferably from 20 to 80 pbw, of the precipitated silica; from 0.1 to 10.0 pbw, even more preferably from 0.5 to 5.0 pbw of the hydroxy terminated polysiloxane; 0.1 to 30 parts by weight of the organohydrogenpolysiloxane; an effective amount of the low compression set additive; and an effective amount of a catalyst.

Compounds suitable as the alkenyl terminated gum component of the composition of the present invention include, for example, vinyl, propenyl, and butenyl terminated gums. In a preferred embodiment, the alkenyl terminated diorganopolysiloxane gum is a vinyl terminated dialkylpolysiloxane gum, more preferably a vinyl terminated

dimethylpolysiloxane gum or a vinyl terminated poly(dimethylsiloxane-co-methylvinylsiloxane).

In a preferred embodiment, the alkenyl terminated diorganopolysiloxane is one according to the formula:

$$M^{vi}D_xD^{vi}_yM^{vi}$$

where M^{vi} is $R^1R^2_2SiO_{3/2}$

D is $R^3_2SiO_{2/2}$;

D^{vi} is $R^4R^5SiO_{2/2}$;

where R^1 and R^4 are each independently $(C_2\text{-}C_6)$alkenyl, preferably vinyl, R^2, R^3 and R^5 are each independently $(C_1\text{-}C_6)$alkyl or $(C_2\text{-}C_6)$alkenyl, preferably $(C_1\text{-}C_6)$alkyl, more preferably methyl, and x and y are chosen so that the viscosity of the gum is in the range of from about 1,000,000 to about 200,000,000 centipoise at 25°C, and having an alkenyl concentration of about 0.001 to about 0.01 mole percent of siloxy units. In one preferred embodiment, preferably, y is 0.

As used herein, "$(C_1\text{-}C_6)$alkyl" means a straight or branched chain alkyl group containing from 1 to 6 carbon atoms per group, such as, for example, methyl, ethyl, propyl, and butyl.

As used herein, "$(C_2\text{-}C_6)$alkenyl" means a straight or branched chain alkenyl group containing from 2 to 6 carbon atoms per group and at least one double bond between two carbon atoms per group, such as, for example, vinyl, propenyl and butenyl.

Compounds suitable as the alkenyl-containing diorganopolysiloxane gum component of the present composition include, for

example, vinyl-, propenyl- and butenyl-containing gums. In a preferred embodiment, the alkenyl units are on-chain. As used herein, "on-chain" means that the alkenyl units are on di-organo-functional siloxane units of the gum. In a preferred embodiment, the alkenyl-containing diorganopolysiloxane gum is a vinyl-containing dialkylpolysiloxane, preferably a vinyl-containing dimethylpolysiloxane, even more preferably trimethyl-terminated poly(dimethylsiloxane-co-methylvinylsiloxane).

In a preferred embodiment, the alkenyl-containing diorganopolysiloxane gum is one according to the formula:

$$MD_wD^{vi}_zM$$

where M is $R^6{}_3SiO_{3/2}$,

D and D^{vi} are as previously described, each R^6 is independently $(C_1\text{-}C_6)$alkyl or $(C_2\text{-}C_6)$alkenyl, preferably $(C_1\text{-}C_6)$alkyl, more preferably methyl, where w and z are chosen so that viscosity ranges from about 100,000 to about 200,000,000 centipoise at 25°C and having an alkenyl concentration of from about 0.5 to about 15 mole percent of siloxy units.

Compounds suitable as the non-fumed silica filler are those that have reinforcing properties for silicone elastomers, such as precipitated silicas and silica gels, preferably precipitated silicas. At least part of the non-fumed silica filler must be a precipitated silica reinforcing filler having a surface area of from about 90 to about 300 m^2/g. Non-fumed silica fillers are known in the art and are commercially available. An example of a non-fumed silica filler suitable for use in the present invention is DeGussa FK-140® precipitated silica, commercially available from DeGussa (New Jersey).

In a preferred embodiment, the hydroxy terminated polysiloxane is one according to the structural formula:

$$MD_aD^{vi}{}_bM$$

where M is $R^7R^6{}_2SiO_{3/2}$,

D and D^{vi} are as previously defined such that the alkenyl content is from 0 to about 2.0 mole percent, each R^6 is as previously defined, R^7 is OH, a and b are chosen such that the viscosity is from about 25 to about 40 centistokes at 25°C.

In a preferred embodiment, the hydride-containing polysiloxane is one according to the structural formula:

$$M^HD_cD_d{}^HM^H$$

where M^H is $R^8R^6{}_2SiO_{3/2}$,

D^H is $R^9R^6SiO_{2/2}$, each R^6 is as previously defined, R^8 and R^9 are each H, and c and d are chosen such that the viscosity is from about 10 to about 1000 centipoise at 25°C and the hydride content is from about 0.05 to about 5.0 percent by weight, subject to the limitation that the molar ratio of the hydride and vinyl content in the composition must be greater than or equal to 4, preferably greater than 6, more preferably from about 6 to about 11.

Compounds suitable as the low compression set additive are those that effectively reduce compression set of the cured silicone elastomer, inhibit cure at room temperature and prevent unwanted cure. Examples of the low compression set additive for use in the present invention include, but are not limited to, acetylene alcohols such as 1-ethynl-1-cyclohexanol ("ECH"), 9-ethynyl-9-fluorenol, and the like, preferably ECH and 9-ethynyl-9-fluorenol, and peroxide inhibitors such as methylethylketone peroxide, and the like, preferably, methylethylketone peroxide. The acetylene alcohols and peroxide inhibitors are known in the art and are available commercially.

In a preferred embodiment, the low compression set additive is an acetylene alcohol having the formula:

$$H\text{-}C{\equiv}C\text{-}R^{10}\text{-}OH$$

wherein R^{10} is a divalent hydrocarbon radical comprising from 6 to 40 carbon atoms where the structure of R^{10} may be any combination of linear, branched, aliphatic, aromatic, cycloaliphatic and olefinic, with the limitation that the alcohol is always in the acetylene position. Preferably, the low compression set additive is 1-ethynyl-1-cyclohexanol or 9-ethynyl-9-fluorenol.

Compounds suitable as the catalyst in the present invention are known in the art. Examples of effective catalysts for use in the present invention are platinum and complexes of platinum that provide at least 0.1 parts per million of platinum in terms of platinum metal. Examples of suitable platinum catalysts include, but are not limited to, platinum black, chloroplatinic acid, alcohol modified chloroplatinic acid, and complexes of chloroplatinic acid with olefins, aldehydes, vinylsiloxanes or acetylene alcohols. A preferred catalyst for use in the present invention is a Karstedt catalyst.

Other optional additives used in the compositions of the present invention are coloring agents and pigments, and standard additives known in the art to improve heat aging and oil immersion, such as iron oxide, extending fillers such as micro mica, cerium hydroxide, and the like.

The process for forming this composition can be either cold mix or hot mix at temperature above 100°C. The cold mix can be achieved using Banbury or Doughmixer equipment. The hot mix can be achieved using either a Doughmixer batch process or an extruder-type continuous process.

The composition of the present invention is used primarily as a heat curable rubber in applications requiring high consistency and malleable compositions. Curing is generally high temperature curing, i.e., at a temperature of about 100°C or higher.

The heat curable silicone elastomer composition of the present invention may be used in a variety of applications, including, for example, automotive gaskets, electronic keyboards, consumer goods such as baby bottle nipples, and the like.

The examples given below are given for the purpose of illustrating the present invention. All parts are by weight. The following chart describes the components used in the examples:

A - vinyl terminated polydimethylsiloxane gum (viscosity 100,000 to 200,000,000 cps)

B - dimethylvinyl terminated poly(dimethylsiloxane-co-methylvinylsiloxane) (viscosity 1,000,000 to 200,000,000 cps)

C - trimethyl-terminated poly(dimethylsiloxane-co-methylvinylsiloxane) (viscosity 1,000,000 to 200,000,000 cps)

D - hydroxy-terminated polydimethylsiloxane (viscosity 25 to 40 centistokes)

E – hydride containing polysiloxane (35 to 75 centistokes)

F - Filler – non-fumed, precipitated silica filler (90 – 300 m^2/g hydrophilic silicon dioxide)

G – low compression set additive – 9-ethynyl-9-fluorenol

H – low compression set additive – ECH

I – Pt catalyst (10% platinum in divinyltetramethyldisiloxane)

Examples 1 to 5 – Precipitated Silica with Low Compression Set, High Tear

In a Farrel Banbury mixer, a platinum catalyst master batch was compounded by combining 2000 grams of component (A) with 20 grams of component (D), 720 grams of component (F) and 10.4 grams of component (I) at a shear rate of 40 r.p.m. at a temperature of from about 20 to about 70°C.

In a Farrel Banbury mixer, a heat curable silicone elastomer composition was compounded by combining 1260 g of component (A) and 380 g of component (C) at a shear rate of 15 r.p.m at 25°C. To this mixture, 40 g of component (D), 54 g of component (E) and 1.2 g of component (H) were added. In addition, to this mixture 880 g of precipitated silica filler (F) was added in three portions. Between each addition of the silica filler, the mixture was mixed with a shear rate of 30 r.p.m at 25 to 70°C for two minutes. At the end of addition of the silica filler, the compound was mixed further for another 5 minutes with a shear rate of 40 r.p.m at 50 to 70°C.

This compound was catalyzed with 1.0 parts by weight of the platinum catalyst master batch produced in Example 0 per 99 parts by weight of the compound. The cure rate and subsequent cure profile were determined by measuring 7.0 grams of the material on a Monsanto Modulating Disk Rheometer ("MDR") at 350°F. The time to 2% and 90% cure were taken from the resulting profile, as well as the maximum torque and peak rate of cure. This catalyzed compound was press-cured for 10 minutes at 177°C and samples were taken to evaluate the mechanical properties. In addition, the press-cured samples were further post-cured by oven baking for 4 hours at

200°C and the physical properties were evaluated. The results of this example, Example 1, are listed in Table 1.

Examples 2 to 5 were made using the same compounding process Example 1 above, except that the amount of each component was changed (as listed in Tables 2 to 4). The results of the tests are listed in Tables 2 to 4.

Comparative Example – Addition Curable Elastomer with Fumed Silica

Two samples of a commercially available heat curable elastomer containing fumed silica (instead of non-fumed, precipitated silica) were tested in the same manner as Examples 1 to 5. The results are shown in Tables 1 and 3.

Example 6 – Precipitated Silica with Low Compression Set, High Tear

The compositions of Examples 1 to 5 can also be produced using a hot mixing process, for example, in a Doughmixer. In a lab Doughmixer, a heat curable silicone elastomer composition was compounded by combining 1215 grams of component (A) and 285 grams of component (C) at a shear rate of 20-30 r.p.m. at 25°C. To this mixture 30 grams of component (D) were added. Between each addition of the filler, component (F), the mixture was mixed with a shear rate of 20-30 r.p.m. at 25-70°C. At the end of the additions, the mixture was mixed for another 15 minutes, then heated to 160°C under a flow of nitrogen and heated for 2 hours at 160°C. At the end of the 2 hour heating, the mixture was cooled to less than 80°C, and 40.5 grams of component (E) and 0.90 grams of component (H) were added and the mixture was further mixed for another 0.5 hours. The compound was then cured and tested in the same manner as described in Example 1. The results are listed in Table 5.

Table 1

Component	Example 1 (pbw)
A	81
C	19
D	2
E	2.7
H	0.06
F	44
Platinum Catalyst	1.0 pts/99 pts compound

Properties				
MDR Results @ 350°F				
T02 (m:s)	0:05			
T90 (m:s)	0:15			
Peak Rate (lb.in/min)	126.80			
Maximum Torque (lb.in)	16.35		HCE with Fumed Silica*	(Comparative Example)
	Press Cure	Post Cure	Press Cure	Post Cure
Molding conditions	350°F/17 min.	350°F/17 min.	350°F/17 min.	350°F/17 min.
Post cure conditions	--	400°F/4 hours	--	400°F/4 hours
Shore A	48.2	47.9	50.0	54.0
Tensile strength, psi	1089	1012	1426	1399
Elongation (%)	593	527	861	783
Modulus @ 50%, psi	109	108	--	--
Modulus @ 100%, psi	182	178	212	260
Modulus @ 200%, psi	346	342	--	--
Tear B, ppi	206	209	311	267
Specific gravity	1.153	1.161	1.154	1.154
Compression Set, 22 hr/177°C	23.4	25.4	--	--

*Commercially available heat curable elastomer containing fumed silica instead of non-fumed silica.

Process condition: Banbury cold mix

Test methods:

Shore A - ASTM D2240

Tensile strength - ASTM D412

Elongation - ASTM D412

Modulus - ASTM D412

Tear B - ASTM D624

Specific Gravity - ASTM D792

Compression Set – ASTM D395

A typical calculation for compression set is:

$$\% \text{ Compression Set} = C = [(Y_0 - Y_1)/(Y_0 - Y_s)]*100$$

where Y_0 = initial thickness, Y_1 = final thickness, and Y_s = 75% of initial thickness

Table 2

Component	Example 2 (pbw)
A	78
C	22
D	2.5
E	3.3
H	0.062
F	50
Platinum Catalyst	1.0 pts/99 pts compound

Properties	
MDR Results @ 350°F	
T02 (m:s)	0:05
T90 (m:s)	0:15
Peak Rate (lb.in/min)	137.80
Maximum Torque (lb.in)	17.35

	Press Cure	Post Cure
Molding conditions	350°F/17 min.	350°F/17 min.
Post cure conditions	--	400°F/4 hours
Shore A	51.3	52.1
Tensile strength, psi	1165	1119
Elongation (%)	616	558
Modulus @ 50%, psi	114	115
Modulus @ 100%, psi	194	193
Modulus @ 200%, psi	377	383
Tear B, ppi	219	182
Specific gravity	1.180	1.180
Compression Set, 22 hr/177°C	24.6	22.0

Table 3

Component	Example 3 (pbw)
A	83
C	17
D	1
E	2.5
H	0.056
F	36
Platinum Catalyst	1.0 pts/99 pts compound
Properties	
MDR Results @ 350°F	
T02 (m:s)	0:05
T90 (m:s)	0:20
Peak Rate (lb.in/min)	73.20
Maximum Torque (lb.in)	12.43

			HCE with Fumed Silica*	(Comparative Example)
	Press Cure	Post Cure	Press Cure	Post Cure
Molding conditions	350°F/17 min.	350°F/17 min.	350°F/17 min.	350°F/17 min.
Post cure conditions	--	400°F/4 hours	--	400°F/4 hours
Shore A	40.3	42.0	41.0	44.0
Tensile strength, psi	976	957	1338	1487
Elongation (%)	603	568	917	745
Modulus @ 50%, psi	87	94	--	--
Modulus @ 100%, psi	140	151	132	180
Modulus @ 200%, psi	259	285	--	--
Tear B, ppi	210	224	260	255
Specific gravity	1.132	1.136	1.118	1.1118
Compression Set, 22 hr/177°C	22.8	18.1	--	--

*Commercially available heat curable elastomer commercially with fumed silica instead of non-fumed silica.

Table 4

Component	Example 4 (pbw)	Example 5 (pbw)
A	90	72
C	10	28
D	1	3.5
E	2.05	3.85
H	0.053	0.066
F	28	58
Platinum Catalyst	1.0 pts/99 pts compound	1.0 pts/99 pts compound
Properties		
MDR Results @ 350°F		
T02 (m:s)	0:05	0:05
T90 (m:s)	0:16	0:15
Peak Rate (lb.in/min)	85.40	148.40
Maximum Torque (lb.in)	11.84	19.50
	Press Cure	Press Cure
Molding conditions	350°F/17 min.	350°F/17 min.
Shore A	35.8	57.2
Tensile strength, psi	1069	1137
Elongation (%)	701	478
Modulus @ 100%, psi	100	262
Modulus @ 200%, psi	177	520
Tear B, ppi	237	235
Specific gravity	1.105	1.206

Table 5

Component		Example 6 (pbw)
Part I		
	A	81
	C	19
	D	2
	F	44
Part II		
	E	0.056
	H	2.7

Platinum Catalyst 1.0 pts/99 pts compound

Properties	
MDR Results @ 350°F	
T02 (m:s)	0:05
T90 (m:s)	0:17
Peak Rate (lb.in/min)	123.10
Maximum Torque (lb.in)	16.16

	Press Cure	Post Cure
Molding conditions	350°F/17 min.	350°F/17 min.
Post cure conditions	--	400°F/4 hours
Shore A	48.6	49.1
Tensile strength, psi	1089	1084
Elongation (%)	486	408
Modulus @ 50%, psi	126	133
Modulus @ 100%, psi	234	253
Modulus @ 200%, psi	448	506
Tear B, ppi	260	116
Specific gravity	1.161	1.167
Compression Set, 22 hr/177°C	24.4	21.6

Process conditions: Doughmixer, 160°C for 2 hours, Part I; after Part II, Doughmixer, 0.5 hours, 40-80°C

9-ethynyl-9-fluorenol as Low Compression Set Additive

Examples 7 to 10

The standard base used in examples 7 to 10 was formulated in a Farrel Banbury mixer by compounding 1620 grams of component (A) and 380 grams of component (B) at a shear rate of 15 r.p.m. at 25°C. To this mixture, 40 grams of component (D) and 58 grams of component (E) were added. 880 grams of precipitated filler, component (F), was added to the mixture in three portions. Between each addition of filler, the mixture was mixed at a shear rate of 30 r.p.m. at 25-70°C for 2 minutes. At the end of the filler addition, the compound was mixed for another 5 minutes with a shear rate of 40 r.p.m. at 50-70°C. The platinum catalyst master batch is the same as previously prepared.

To 100 parts of the base material, the appropriate amount of additive was added (see Table 6), in a solvent or master batch where necessary, and the composition was roll milled at lest 25 times to ensure complete dispersion. The resulting composition was catalyzed with 1.0 parts by weight of the Platinum catalyst master batch per 99 parts of the compound. The cure rate and subsequent cure profile was determined by measuring 7.0 grams of the material produced on a Monsanto Modulating Disk Rheometer ("MDR") at 150°C. The time to 90% cure was taken from the resulting profile. This catalyzed compound was press-cured for 10 minutes at 177°C, and samples were taken to evaluate properties. Results are shown in Table 6.

Example 11 – Comparative Example

A compound was produced in the same manner as in Examples 7 to 10 except that the additive was 1-ethynyl-1-cyclohexanol (ECH). The results of the evaluation are shown in Table 6.

Table 6

Component	Ex. 7	Ex. 8	Ex. 9	Ex. 10	Ex. 11 (comp.)
	(pbw)	(pbw)	(pbw)	(pbw)	(pbw)
A	81.0	81.0	81.0	81.0	81.0
B	19.0	19.0	19.0	19.0	19.0
D	2.0	2.0	2.0	2.0	2.0
E	2.9	2.9	2.9	2.9	2.9
F	44.0	44.0	44.0	44.0	44.0
Platinum Catalyst	1 pbw/99 pbw comp.	1 pbw/99 pbw comp.	1 pbw/99 pbw comp.	1 pbw/99 pbw comp.	1 pbw/99 pbw comp.
G	240 ppm	265 ppm	400 ppm	663 ppm	--
H	--	--	--	--	400 ppm
Properties					
T90 @ 150°C (m:s)	0:29	0:25	0:26	0:29	0:24
Hardness Shore A	52	53	53	52	51
Tear B, ppi	270	177	246	283	220
Comp. Set at 177°C, 22 hours	13.0	13.3	14.0	15.0	22.6

CLAIMS

I now claim:

1. A curable composition comprising:

(a) an alkenyl terminated linear diorganopolysiloxane gum;

(b) an alkenyl containing diorganopolysiloxane gum;

(c) a precipitated silica reinforcing filler with surface area of from about 90 to 300 m^2/g;

(d) a hydroxy terminated polysiloxane fluid;

(e) an organohydrogenpolysiloxane;

(f) an effective amount of a low compression set additive; and

(g) an effective amount of an addition-cure catalyst.

2. The composition of claim 1, wherein the composition comprises:

(a) from 60 to 98 parts by weight of the alkenyl terminated linear diorganopolysiloxane gum;

(b) from 2 to 40 parts by weight of the alkenyl containing diorganopolysiloxane gum;

(c) from 10 to 200 parts by weight of the non-fumed silica;

(d) from 0.1 to 10.0 parts by weight of the hydroxy terminated polysiloxane fluid; and

(e) from 0.1 to 30 parts by weight of the organohydrogenpolysiloxane.

3. A silicone elastomer formed by curing the composition of claim 1.

4. The composition of claim 1, wherein the molar ratio of hydride to vinyl is greater than or equal to 4.

5. The composition of claim 4, wherein the molar ratio of hydride to vinyl is from about 6 to about 11.

6. The composition of claim 1, wherein the alkenyl terminated linear diorganopolysiloxane gum has the formula:

$$M^{vi}D_xD^{vi}{}_yM^{vi}$$

where M^{vi} is $R^1R^2{}_2SiO_{3/2}$

D is $R^3{}_2SiO_{2/2}$;

D^{vi} is $R^4R^5SiO_{2/2}$;

where R^1 and R^4 are each independently $(C_2$-$C_6)$alkenyl, R^2, R^3 and R^5 are each independently $(C_1$-$C_6)$alkyl or $(C_2$-$C_6)$alkenyl, and x and y are chosen so that the viscosity of the gum is in the range of from about 1,000,000 to about 200,000,000 centipoise at 25°C, and having an alkenyl concentration of about 0.001 to about 0.01 mole percent of siloxy units.

7. The composition of claim 6, wherein R^1 and R^4 are vinyl.

8. The composition of claim 6, wherein R^2, R^3 and R^5 are each methyl.

9. The composition of claim 6, wherein y is 0.

10. The composition of claim 6, wherein y > 0.

11. The composition of claim 1, wherein the alkenyl containing diorganopolysiloxane gum has the formula:

$MD_wD^{vi}_zM$

where M is $R^6{}_3SiO_{3/2}$,

D is $R^3{}_2SiO_{2/2}$;

D^{vi} is $R^4R^5SiO_{2/2}$;

where each R^4 is independently (C_2-C_6)alkenyl, R^3, R^5 and R^6 are each independently (C_1-C_6)alkyl or (C_2-C_6)alkenyl, where w and z are chosen so that viscosity ranges from about 100,000 to about 200,000,000 centipoise at 25° C and having an alkenyl concentration of from about 0.5 to about 15 mole percent of siloxy units.

12. The composition of claim 11, wherein each R^3, R^5 and R^6 is methyl.

13. The composition of claim 12, wherein R^4 is vinyl.

14. The composition of claim 1, wherein the hydroxy terminated polysiloxane fluid has the formula:

$MD_aD^{vi}_bM$

where M is $R^7R^6{}_2SiO_{3/2}$,

D is $R^3{}_2SiO_{2/2}$;

D^{vi} is $R^4R^5SiO_{2/2}$;

where each R^4 is independently (C_2-C_6)alkenyl, R^3 and R^5 and R^6 are each independently (C_1-C_6)alkyl or (C_2-C_6)alkenyl, such that the alkenyl content is from 0 to about 2.0 mole percent, R^7 is OH, and a and b are chosen such that the viscosity is from about 25 to about 40 centistokes at 25°C.

15. The composition of claim 14, wherein each R^3 and R^5 and R^6 is methyl.

16. The composition of claim 14, wherein R^4 is vinyl.

17. The composition of claim 1, wherein the organohydrogenpolysiloxane has the formula:

$$M^H D_c D_d^H M^H$$

where M^H is $R^8R^6_2SiO_{3/2}$,

D^H is $R^9R^6SiO_{2/2}$, each R^6 is independently $(C_1\text{-}C_6)$alkyl or $(C_2\text{-}C_6)$alkenyl, R^8 and R^9 are each H, and c and d are chosen such that the viscosity is from about 10 to about 1000 centipoise at 25°C and the hydride content is from about 0.05 to about 5.0 percent by weight.

18. The composition of claim 17, wherein each R^6 is methyl.

19. The composition of claim 1, wherein the low compression set additive is an acetylene alcohol having the formula:

$$H\text{-}C{\equiv}C\text{-}R^{10}\text{-}OH$$

wherein R^{10} is a divalent hydrocarbon radical comprising from 6 to 40 carbon atoms where the structure of R^{10} may be any combination of linear, branched, aliphatic, aromatic, cycloaliphatic and olefinic, with the limitation that the alcohol is always in the acetylene position.

20. The composition of claim 19, wherein the low compression set is 1-ethynl-1-cyclohexanol.

21. The composition of claim 1, wherein the low compression set additive is 9-ethynyl-9-fluorenol.

22. The composition of claim 1, wherein the low compression set additive is peroxide.

23. The composition of claim 22, wherein the peroxide is methylketone peroxide.

HIGH TEAR STRENGTH LOW COMPRESSION SET HEAT CURABLE SILICONE ELASTOMER

ABSTRACT

A high tear strength, low compression set, low cost heat curable silicone elastomer.

Docket: 60SI01932

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: HIGH TEAR STRENGTH LOW COMPRESSION SET HEAT CURABLE SILICONE ELASTOMER AND ADDITIVE, the specification of which:

X is attached hereto.
__ was filed on ______ as Application Serial No.____
and was amended on ______________________.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information which is material to patentability (as defined in 37 C.F.R. § 1.56) in connection with the examination of this application.

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the matter provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

Country	Application No.	Date of Filing	Priority Claimed

I hereby appoint, Henry H. Gibson, Reg. No. 28,951; Robert E. Walter, Reg. No. 25,245; and Kenneth S. Wheelock, Reg. No. 36,340, John B. Yates, Reg. No. 39,433, Kevin E. McVeigh, Reg. No. 33,017, Frank A. Smith, Reg. No. 39,375, Michelle Bugbee, Reg. No. 42,370 all of General Electric Company, One Plastics Avenue, Pittsfield, MA 01201Ronald E. Myrick, Reg. No. 26,315 of General Electric Company, (W3E) 3135 Easton Turnpike, Fairfield, CT 06431-0001, Henry J. Policinski, Reg. No. 26,621 of General Electric Company, (W3D) 3135 Easton Turnpike, Fairfield, CT 06431-0001, Pamela Curbelo, Reg. No. 34,676, Leah Reimer, Reg. NNo. 39,341, Michael A. Cantor, Reg. No. 31,152 and J. Michael Buchanan, Reg. No. 44,571 all of Cantor Colburn LLP, 55 Griffin Road South, Bloomfield CT 06002 jointly and each of them severally, my attorneys or agents and attorney or agent, with full power of substitution, delegation and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent and to transact all business in the Patent and Trademark Office connected therewith. We hereby direct that all correspondence and telephone calls in connection with this application be addressed to the said:

Kevin E. McVeigh at General Electric Company, One Plastics Avenue, Pittsfield, MA, 01201
Telephone No.: (413) 448-4730

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that all such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature Yi-Feng Wang July 24, 2000
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